

**Clean Energy Systems, Inc. Comments on ARB's
Proposed Early Actions to Mitigate Climate Change in California Report
Dated April 20, 2007**

Clean Energy Systems, Inc. (CES) commends and appreciates the work done and being done by the Air Resources Board (ARB), the Climate Action Team (CAT), the Public Utilities Commission (PUC), and the California Energy Commission (CEC) in anticipation of and in compliance with AB 32 and other related laws. There has been substantial identification and clarification of issues involved in the management of influences on climate change. One issue area that has not received significant attention is the establishment of effective controls to transition to "climate neutral" combustion of fossil fuels and "climate negative" combustion of renewable fuels, to the extent possible.

In an effort 1) to explain the available alternatives for dealing with this issue area, 2) to quantify the results possible in addressing this area, and 3) to point out possible strategies for early actions addressing this subject at this time, we have prepared the following comments.

Solution Screening Criteria and Its Application to CO₂ Capture Storage Technologies

The ARB has established screening criteria for proposed solutions to include in "discrete early action measures." In summary the criteria require that:

- 1) the technology to eliminate emissions must exist today;
- 2) the implementation will produce significant GHG emission reductions;
- 3) implementation will have no adverse impact on the environment;
- 4) there will be no disproportionate impacts on low income or small business communities, *i.e.*, solutions will be socially just;
- 5) actions will be consistent with EPA and international agency initiatives; and
- 6) actions will meet the need to protect public health.

The ARB Early Actions for Climate Change in California presentation on April 23, 2007 stressed that public health comes first. That presentation stressed the importance of achieving:

"... PM, NO_x and VOC reduction ... first ... while combining this effort with GHG reductions whenever possible."

Applying "carbon neutral" process technologies, such as Carbon Capture Storage (CCS), to existing and new fossil fueled power plants meets the above criteria and will result in significant GHG, NO_x and PM 10 reductions by 2020. As an example, a modest application of oxy fuel capture to new natural gas power plants will result in annual reductions of 3.7, 5.5 and 10.5 MMT CO₂E/yr by 2020, depending upon the implementation schedule. In addition, 121,187 and 374 tons/yr respectively of PM 10 emissions would also be avoided. Applying other CCS (*i.e.* pre combustion capture and post combustion capture) to existing power plants could achieve even greater results.

The IPCC Special Report on Carbon Dioxide Capture and Storage documented the vital role that CCS could play to help reduce CO₂ emissions along with other techniques such as renewable energy and improved efficiency. In each case analyzed, CCS contributes around a quarter of the

emission reductions required to control global warming. With their MiniCAM scenario, the IPCC estimates that, by the year 2020, CCS can contribute an equal or greater amount than that provided by renewable energy, conservation and energy efficiency.

The Major Problem Is and Will Be the Combustion of Fossil Fuels

The substantial majority of power generated today in California and in the nation is produced by combustion of fossil fuels. Because of availability and economics, dominance of electric power generation by fossil fuels will continue for decades, if not centuries. Traditional fossil fuels are burned in a “carbon positive” environment whereby carbon, in the form of oil, gas and coal, is taken from the earth and discharged into the atmosphere as CO₂, and PM 10. As a result, the Federal and State governments have implemented various programs to encourage the use of “climate neutral” (i.e. renewable fuels) over fossil fuels. With renewable fuels (such as cheap residues) plants capture CO₂ from the atmosphere (by photosynthesis) and, when they are used as a fuel, most of that CO₂ is returned to the atmosphere, without a net gain of CO₂.

Recognizing that fossil fuels will continue to be 43 percent or more of our power generation, the State should be advancing similar programs that will require that fossil fuels be used in a “climate neutral” manner. To use a fossil fuel in a “climate neutral” manner, the CO₂ and other emissions must not be discharged into the atmosphere. With CCS technologies, fossil fuels can be burned in a “climate neutral” environment with the emissions being returned back to the earth and permanently sequestered.

As an enhancement to the use of renewable fuels, it is possible to utilize these fuels in a “carbon negative” environment. With CSS technology, the CO₂, captured by the plants from the atmosphere, would be permanently sequestered. With today’s climate issues, this is the ideal CO₂ cycle since the energy benefit of the renewable is realized while achieving a net reduction of atmospheric CO₂.

Fuels (Fossil and Renewable) Should Be Used in the Most Environmentally Beneficial Manner Possible

Significant effort and governmental attention have been applied to encouraging use of renewable technologies in power generation for more than two decades. Utilities are currently required to use renewable fuel generation as State governments mandate percentages of power to be produced from renewable sources. Federal subsidies exist for renewables to offset their higher production costs. Despite the fact that the substantial majority of power is generated by the combustion of fossil fuels, there are no comparable mandates to require utilities to transition their fossil fueled power plant portfolios to “climate neutral” technologies. Technologies, such as CSS, exist that enable pollution free, fossil fueled power generation, but such technologies are locked out of effective competition due to the utilities’ and regulators’ total focus on renewable energy.

In concert with the need for additional renewable energy, the transition to the “climate neutral” use of fossil fuels must be incentivized. Power plant policies that mandate the use of fossil fuels in a “climate neutral” and renewable fuels in a “climate negative” process should be a major driving force in reshaping the means by which electricity is produced within California.

Availability of Technology

CCS technology involves capturing the CO₂, produced by the burning of hydrocarbon and renewable fuels, before it enters the atmosphere, and storing it deep underground in rock formations, including gas and oil reservoirs, where it remains indefinitely. CCS is most cost effective when applied to stationary sources of CO₂ (such as power plants) which account for more than half of all man-made CO₂ emissions. The CO₂ can be captured before (pre combustion capture), during (oxyfuel capture) or after (post combustion capture) burning and the technology to do this is already in many industries.

While funding for the development of the oxyfuel combustion technology has come from the California Energy Commission, Europe is further ahead than California in implementing the technology. In Norway, the Zero Emissions Norwegian Gas (ZENG) Project is being jointly developed by Lyse Energi AS, Nebb Engineering AS, Procom Venture AS, and CO₂-Norway. The goal of this program is to develop and demonstrate technology for Zero-Emission Power Plants (ZEPP) using Norwegian natural gas in combination with the oxy-combustion cycle developed by CES. In the Netherlands, the Dutch SEQ-1 Project will use a modified CES process in which oxy-fuel combustion drives conventional steam turbines, producing 50 MW_e and using the CO₂ exhaust stream for enhanced gas recovery (EGR). Recently, a Middle East country has indicated their willingness to utilize oxy fuel combustion and CO₂ capture as one of the primary power generation technologies to power an emerging world class city. Other CCS projects, using other technology suppliers, are underway in Canada, Germany, France and Australia.

In California, CES has proposed a 50 MW Zero Emission Power Plant (ZEPP) that will utilize the CO₂ in an enhanced oil recovery (EOR) application. The project will be in commercial operations by early 2010 and bring many benefits to California citizens including the generation of power from fossil and renewable fuels with zero CO₂, NO_x and PM 10 emissions to the atmosphere; increased oil tax revenues from the use of the CO₂, competitively priced electricity at or below the cost of renewable alternatives and the introduction of one of the first power “climate neutral” generating technologies in California

GHG Emission Reductions Will Be Significant

As described above, there are several CCS technologies that can reduce the CO₂ emissions from existing and new power plants. These technologies are applicable to the combustion of fossil and renewable fuels. It is impossible for CES to estimate the total reductions that could be achieved by using CCS in those installations/applications where it makes economic sense. However, CES can estimate the benefits that its technology would achieve if implemented in a reasonable schedule.

If California added 100 MW per year, starting in 2007 with the first commercial operations in 2010, the reduction in CO₂ and PM 10 emissions by 2020 would be 3.7 MMTCO₂E/yr and 121 tons/yr respectively. If a more aggressive schedule of 100 MW/yr for the first 5 years and 200 MW/yr for the following 6 years was followed, the 2020 reductions would be 5.7 MMTCO₂E/yr of CO₂ and 187 tons/yr of PM 10. Finally, if the State achieved zero emissions for 100 MW/yr in years 2010-2012, 200 MW/yr in years 2013-2015 and 500 MW/yr in 2016-2020; the annual reduction by 2020 would be 10.5 MMTCO₂E/yr of CO₂ and 374 tons/yr of PM 10. Relative to

the other strategies identified as underway or to be initiated by ARB in the 2007-2009 period, these are major reductions and have a high probability of success.

Each of these schedules is technically and economically achievable. The level of GHG and PM 10 savings will be most likely dependent upon the time and effort that is dedicated to achieving “climate neutral” combustion process of fossil fuels as compared to only looking at the fuel source and accepting the traditional “carbon positive” processes even when more beneficial climate alternatives are available.

The above implementation proposals are for only a fraction of the new power plants that need to be installed between now and 2020. While the logistics of power plant siting preclude all of the State’s generation being located where EOR opportunities exist, a portion of the new plants can be located in these areas to achieve the significant environmental benefits that CCS offers.

Implementation Proposed Would Have Beneficial Affect on the Environment.

Implementation of the technologies discussed above not only would have no adverse impact on the environment; the technology would be an assist in so far as oxycombustion systems, using hydrocarbon fuels can be net producers of distilled water. The technology described above, developed and demonstrated in California, in a 100 MW natural gas fueled plant produces net water at a rate of 10,000 gallons/hr (250,000 gallons/day). Such plants will operate without a smokestack when all CO₂ is separated and captured for market purposes or for sequestration. There will be no releases to the atmosphere, other than minimal periods during plant startup and shutdown.

No Impacts on Low Income or Small Business Communities, *i.e.*, Socially Just

It is not anticipated that electricity costs would rise significantly (they will be reduced over time as plant efficiencies increase). There would be enhancement rather than degradation of neighborhoods using the cleaner zero emission plants, and the public health would be substantially assisted by the elimination of regulated pollutants. Implementation of early actions addressing cleaner fossil fuel plant operations will be a totally socially just development.

Consistent with EPA and International Agency Initiatives

There are no known EPA regulations, State or Federal, and there are no known international agency requirements that would impede or be contrary to the implementation of early actions addressing the reduction of emissions from fossil fueled power generating plants. As discussed earlier, the IPCC expects that CCS can contribute around a quarter of the emission reductions required to control global warming.

Protect Public Health.

The American Lung Association has estimated that two thirds of Americans live in areas failing to meet the National Ambient Air Quality Standards. A joint EPA Harvard School of Public Health study reported that analyses of air quality morbidity indicate that up to 64,000 Americans die prematurely every year from illnesses exacerbated by air pollutants. Combustion of fossil fuels is a major contributor to these identified problems. With technologies now available, and

appropriate incentives established to stimulate industry use of the technologies, it is entirely possible today to provide for power without pollution. Thus, implementation of actions proposed in these comments can significantly assist and will protect public health.

In addition to the GHG reductions achieved with the CCS technology, the oxy fuel combustion process will eliminate any PM, NO_x or VOC emissions to the atmosphere. In the April 23, 2007 Second Public Workshop, the ARB stated that “PM, NO_x and VOC reductions come first but staff will combine with GHG reductions whenever possible.” The oxy fuel CCS technology meets this requirement and provides benefits to all.

Means of Implementation

The State could adopt at least two parallel early action strategies to achieve the benefits CSS has to offer:

First, the State should introduce gradually increasing requirements for power generators to reduce CO₂, NO_x, and PM emissions from existing portfolios of fossil fueled generation plants. “Grandfathering” all existing plants is inconsistent with the spirit of AB 32, and the climate change issues facing California. In the initial years, meeting a gradually declining threshold of CO₂ emissions from an existing portfolio of plants will be done largely by fuel switching and dispatching decisions. This first phase may not have a major impact on the introduction of “climate neutral” fossil fuel combustion processes. The government need not enter into business decisions on choices of the best or most efficient means of meeting the requirements imposed. These should be business decisions based on competitive market factors.

The Second strategy should address the encouragement of “climate neutral” fossil fuel technologies which will lower fossil fuel system emissions. This strategy should not impair or restrict the program to make renewable energy a larger share of power generation systems. Instead, it should assure that the environmental benefits from “climate neutral” combustion of fossil fuels and “carbon negative” combustion of renewable fuels are achieved within an acceptable time period consistent with the objectives of AB 32. With existing CCS technologies, it is now possible to build, and possibly retrofit existing plants, whereby zero or near zero emissions are realized. Similar to the best means to reduce power plant portfolio emissions, the government does not need to enter into the business decisions as to the choice of the best technology. Instead, it can rely on competitive market factors to develop and advance the technological approaches that best meet the needs of the California power system.

Additional Information

Explanations in detail of the technology described in these comments are available on the website at www.cleanenergysystems.com. Additional information may be obtained through Mr. Leonard Devanna at (916) 379-9143, or by email at lrdevanna@cleanenergysystems.com.